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MINT OF THE UNITED STATES,

MELTING & REFINING DEPARTMENT,

Philadelphia, 10th June. 1879

Sir

I herewith offer you the results of the Experiments made with Mr. A. E. Outerbridge's apparatus on volatilization of standard silver, & its recovery from vapor, within the last two weeks. The following statement of the amount worked, & produced, & of apparent wastage, will exhibit the whole operation.

	St. oz.	St. oz.
Amount worked		17,629.38
Ingots delivered	17,278.68	
Bars, tops, & filings, of ingots	280.99	
Grains gathered (with 3/1000 Gold)	.99	
Grains gathered from volatilization	1.01	17,561.67
apparent wastage		67.71

It is extremely annoying that the very large apparent wastage of 67 71/100 oz. should have occurred in experimental melts. We are ~~shocked~~ pained by its occurrence one or more times every month, & having proved

over

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& over again, that it has been due to misreading or misrecording weights, oftenest to intermixture of different lots or parts of lots, in our crowded vaults, & finding that such results do not exhibit themselves at our settlements, we are obliged to rest content with them, & the anxiety they engender, until we can devise some improvement to be apparent in successive daily workings. Thus the average loss on rid of the anomaly of alternate loss & gain. This is certain daily workings last year (1877-8) was about .0075. whereas at the annual settlement it was only .000-15 or that Mr Outerbridge's apparatus or process is not responsible for the error. + to of the legal allowance

Throwing this irregularity aside for the present in order to examine Mr Outerbridge's results & conclusions, & assuming the average apparent daily wastage observed during the past year in melting ingots, say .000-75, which would be in this case about 13 ounces, — we are struck with the small amount volatilized, 1 oz., or 1/13 of the apparent wastage. ~~Since only standard metal only was employed, our conclusion, is that in melting standard metal~~ From ~~this trial by Mr Outerbridge~~ the single alone we learn that in melting silver ingots the amount volatilized from within the melting pot, is only (more exactly .000-057 (6/100000)) of the whole amount worked. This conclusion (alone) is of value, ~~& should be~~ & will & doubtless

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in the main ~~more or~~ be confirmed by further experiment, for I think we may safely assume that he recovered the silver all that vaporized from the interior of the pot. The following table will shows the proportion he saved of the whole actual & final wastages of the two last years

On settlement 30 June 1877 wastage of silver .000-25

" " 1878 " " .000-15

Volatilized silver condensed by Outerbridge .000-06

His The principles involved in his apparatus are quite sound & the results satisfactory.

In regard to the apparatus, I am disposed to iterate what I think I said before, that it only requires a little time thoughtful & practice to perfect its, ~~so as to make it~~ & adaptation to general use, and I hope ~~That~~ Mr O. may be encouraged to do so.

I have avoided ~~a comparison of the~~ a conclusion as to the actual amount saved by Mr O's process apparatus, in comparison with our own work 1st because it is yet ~~as it~~ his apparatus will be yet further improved, & 2nd because we actually save a portion of the vapors arising from the surface of melted silver in the pot, by closing the drafts of the furnace ~~in~~ when at work, so that some of the vapor certainly escapes into the air of the room, ~~fall on~~ & is daily swept up from the floor to pass into the sweep. We only know this last fact, but absolutely nothing of the amount so saved, Nevertheless ~~it would be far better to save~~ we would doubtless save more & with more certainty by ~~a good~~ an arrangement

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made for the express purpose than trust to haphazard ~~saving~~ economy
~~volatilization of silver from other metals than Copper~~ with embrittling metals. principle ×

2. ~~Independently of economy~~ Mr. O's apparatus ~~is well~~ are
adapted to ~~determine~~ answer some questions ~~that have not been~~ in regard to the Royal metals never yet de-
termined at all or at ~~least~~ best in ~~a very~~ an unsatisfactory
manner; such as I allude to the volatilizing ~~ty of metals~~ zing influences of
~~base~~ metals or metalloids more or less frequently associated with ~~Gold~~ &
Silver, of these queries, several occur important to me now, ~~have occur~~ & are among Mr O's desig/14
~~I conceive of two series~~, — to determine the vola-
tilization of the noble metals with each of these associates separately,
then conjointly, and lastly, when alloyed with copper, as standard metal. One probable
The advan-
tage of examining these influences separately will be, that we may discover
~~be observed~~ practical some external evidences of their presence as a guide to
the melter, & ~~that~~ as a consequence we can ~~experiments can be~~ more satisfactorily ~~made to~~
devise a method of ~~removing these~~ injurious comparisons.

3. I further ~~think~~ I am justified in recommending that
a parallel series of experiments on Gold & its alloys should be
made by Mr O's apparatus, when time & opportunity convene.

~~What~~ ~~These experiments will not add to Mr O's reputation~~, they
I do not doubt but that these experiments
will, ~~I doubt not~~, prove of ~~great~~ value to the economic working
of the precious metals (by the U. S. Govt in coinage) ~~I will I~~
~~doubt reflect favorably on the Governing powers that~~

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3d. When we examine the ratio of the amount of silver volatilized, from within the melting pot to the amount of wastage at the end of the year (as shown above in Sec. 2) 6 to 15 or 25 (we know that ~~.000-09~~ 9 to 19 / 100 000 have been lost in other ways, & since we have carefully gathered all the fragments & dust from every ~~source~~ locality within our reach, ~~the~~ I think we must draw the conclusion that the loss is largely due to volatilization from the body of the furnace, & therefore from metal spilled, ~~or leaking from the~~ in it crucible. We are subject continually to spilling & splashing particles of ~~the~~ melted in ladling it out to cast, and ~~these~~ the remainder of these particles we get from the ashes, from the lining of the furnace, &c. ~~The~~ That which adheres to the sides of the furnace is for a long time exposed to the draft of air passing up through the furnace at a bright red heat, & some of it must although be volatilized. I have long been aware of this & have ~~been somewhat successful in dim~~ endeavored to diminish this personal error of a melter, ~~with some success~~ yet improvement in this direction is much needed, & can only be most successful in ~~not~~ pouring ~~but~~ instead of ladling out of the ~~pot~~ melting pot. Mr. C's experiments have & confirmed my conclusions. It is this view ~~that~~ (that most of the loss is due to accidental spilling, in spite of extreme care), that led me long since to recommend the construction of condensing chambers, where all volatilizing matters would condense & be gathered,

from what soever they arose. While I admire Mr. O's prin
ciple & the general nature of his improvement, & wish to see it
perfected & brought into use, I still think the condensing chambers should
also be employed; for we can hardly overdo the work of saving
in treating gold & silver.

5. In regard to Mr. O's apparatus, I am disposed to iterate
what I formerly said that it only requires a little time, & thoughtful
practice to perfect its adaptation to a more economi-
cal working of the precious metals for coinage; and that even now
it is well suited to determine the reasons of loss in melting
the precious metals & their remedy for the loss. I respectfully
draw attention to his discovery in using the present form
of hood, viz. that it actually diminishes the draft of air over the
surface of the melted metal, & hence tends to diminish its volatiliza-
tion; for I am well satisfied from long & varied observation,
confirmed by that of others, that a current of any gas or vapor
over the surface of melted gold or silver, & especially of the latter, will
inducingly carry up small quantities of that metal
to be partly deposited in the flue & partly thrown into the outer air

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From the above statement ~~I have just made~~ there are several inferences of value.

(over)

1. By comparing the amount gathered from volatilization, .36 oz. which I think may be assumed safely to be all that volatilized from the metal within the ~~with~~ crucible, with the total apparent wastage 68.36 oz. ~~More~~ it is at once manifest that wastage is ~~due~~ almost wholly due to spilling of metal in various ways into the fire. ~~The~~ The experiments on volatilization are valuable, if only to settle this single ~~point~~ point. It is true that ~~in our daily workings~~, the above wastage is 4 or 5 times as much as in our daily workings, & I have the excess ~~shown that~~ is to be ascribed chiefly to the iron ring of the experimental apparatus narrowing the mouth of the crucible & making it difficult to ladle out metal without striking the ring, & so projecting or dropping ~~some~~ a little metal into the fire. But some of the excess of wastage is most likely ~~may be~~ due to the extreme difficulty of keeping the grains of each day or operation, apart from others grains in the confined space in the sweep cellar. The ~~presence of~~ exceeding smallness of the grain bar, about 1 oz., & the presence of gold in it, show to me that the true grains of the experiment have mingled with others nevertheless, if we assume the wastage to have been as is usual in our daily ~~operation~~ silver & gold melting, ~~the important~~ say 10 @ 18 oz., ~~still~~ the important conclusion is clear that nearly all the

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The apparent wastage of 68 3/8 oz. is extremely annoying ~~as~~ especially in ~~an~~ experimental melting, & led me to examine the subject minutely, to discover the cause. The only conclusion that I can safely draw is that which I have often proved in our large daily melting, that occasional errors in weights, reading or recording ~~&~~ occasionally, more or less spilling & accidental mingling of parts of different slots into the fire, are the chief, I think I may say, the only causes of the irregular returns of wastage, & that the present case is an instance. Certain it is that when we carefully close a series of accounts the total wastage is materially diminished.

Throwing aside ~~to actual~~ the apparent wastage for the purpose of examining Mr. Outerbridge's experiment, & adopting the general average wastage in melting upper slots = about 13 oz. .000-75, ~~the 1st inference of importance drawn from his experiment is that~~ undoubtedly Mr. Outerbridge's apparatus or process is not responsible for the excessive wastage.

the most striking fact is ~~that in the~~ the exceeding small amount volatilized, ~~36~~ 3/8 of an ounce, compared with the large amount of usual apparent wastage 13 oz.. I can see no room for any fallacy whatever in the working of Mr. Outerbridge's ~~apparatus~~ principle